Dissertation on

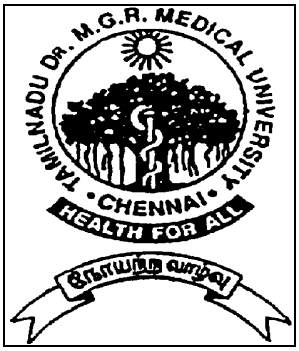
ULTRASONOGRAPHIC FINDINGS IN OCULAR CONDITIONS WITH HAZY MEDIA

Submitted in partial fulfillment of requirements of

M.S. DEGREE BRANCH III
OPHTHALMOLOGY

of

THE TAMILNADU
Dr. M.G.R. MEDICAL UNIVERSITY,
CHENNAI.



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MARCH 2008

CERTIFICATE

This is to certify that this dissertation in "ULTRASONOGRAPHIC FINDINGS IN OCULAR CONDITIONS WITH HAZY MEDIA" is a work done by Dr.GANADIN, under my guidance during the period 2005 - 2008. This has been submitted in partial fulfillment of the award of M.S. Degree in Ophthalmology, (Branch - III) by the Tamil Nadu Dr. M.G.R. Medical University, Chennai - 600 032.

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DECLARATION

I, **Dr.GANADIN** solemnly declare that the dissertation titled **"ULTRASONOGRAPHIC FINDINGS IN OCULAR CONDITIONS WITH HAZY MEDIA"** has been prepared by me. This is submitted to The Tamil Nadu Dr. M.G.R. Medical University, Chennai, in partial fulfilment of the requirement for the award of M.S., degree Examination to be held in March 2008.

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Date:

ACKNOWLEDGEMENT

I would like to thank **Prof.Dr.KALANITI., M.D.,** Dean, Madras Medical College and Research Institute for giving me permission to conduct the study in this Institution.

With overwhelming respect and profound gratitude, I thank **Prof. Dr.V.VELAYUDHAM, M.S., D.O.,** Director, Regional Institute of Ophthalmology and Govt. Ophthalmic Hospital, Chennai, for assigning this topic for study and also for his guidance through out my post graduate course.

I am very grateful to **Prof.Dr.M RADHAKRISHNAN.MS., D.O.** Unit Chief, for having taught me the basics of ultrasonography and for his encouragement and advice.

I wish to express my sincere thanks and gratitude to my Unit Chief, **Prof. Dr.K.VASANTHA, M.S., FRCS,** for the valuable help rendered at various stages of the study and also for her guidance through out my post graduate course.

My heartfelt thanks to **Dr.M.ANANDA BABU, Dr.M.R.CHITRA and Dr.K.MOHAN**, for their help in conducting this study. I wish to express my sincere thanks to all the **Professors, Assisstant professors** and all my **colleagues** who helped me in bringing out this study.

I am indebted to all my patients for their sincere cooperation for completion of this study.

CONTENTS

INTRODUCTION

It has been said that ocular ultrasound takes a weekend to learn and a lifetime to master. When direct observation of intraocular anatomy is obscured, the B-scan is the tool of choice for the evaluation of the eye and orbit.

HISTORY

Ultrasonography was first used for military purposes in submarines to detect far off enemy vessels. Its use in ophthalmology as a diagnostic tool was first reported by **Mundt and Hughes** in 1956.Immersion B scan was introduced by **Baum and Green** 2 years later. **Bronson** developed contact B scan in 1972. Standardized echography describes specialized echographic examination technique of eye using a unique standardized A scan and a contact B scan introduced by **Ossoinig** in 1973.

PHYSICS

Ophthalmic ultrasonography uses high-frequency sound waves, which are transmitted from a probe into the eye. As the sound waves strike intraocular structures, they are reflected back to the probe and converted into an electric signal. The signal is subsequently reconstructed as an image on a monitor, which can be used to make a dynamic evaluation of the eye or can be photographed to document pathology.

Sound is emitted in a parallel, longitudinal wave pattern, similar to that of light. The frequency of the sound wave is the number of cycles, or oscillations, per second measured in hertz (Hz). For sound to be considered ultrasound, it must have a frequency of greater than 20,000 oscillations per second, or 20 KHz, rendering it inaudible to human ears. The higher the frequency of the ultrasound, the shorter is the wavelength (distance from the peak of one wave to the peak of the next wave). A direct relationship exists between wavelength and depth of tissue penetration (the shorter the wavelength, the more shallow the penetration). However, as the wavelength shortens, the image resolution improves.

The acoustic impedance or the ease with which sound travels in a medium is given by the formula;

Acoustic impedance = Sound velocity x Density of the medium

Greater the difference in Acoustic impedance of the two media, greater is the reflection at the interface. The reflected waves or echoes give rise to the term Echography.

Resolution is the smallest distance between two interfaces that can be displayed on the scan. Shorter wavelengths have higher resolution but lesser tissue penetration. Given that ophthalmic examinations require little in the way of tissue penetration (an eye being 23.5 mm long on average) and much in the way of tissue resolution, ultrasound probes used for ophthalmic B-scan are manufactured with very high frequencies of about 10 million oscillations per second, or 10 MHz. In contrast, ultrasound probes used for purposes such as obstetrics use lower frequencies for deeper penetration into the body, and, because the structures being imaged are larger, they do not require the same degree of resolution. Recently, high-resolution ophthalmic B-scan probes (ultrasound biomicroscopy or UBM) of 20-50 MHz have been manufactured that penetrate only about 5-10 mm into the eye for detailed resolution of the anterior segment.

FACTORS INFLUENCING INTENSITY OF ECHOES

Angle of incidence

The angle of incidence of the probe is critical for both A-scan and B-scan ultrasonography. When the probe is held perpendicular to the area of interest, more of the echo is reflected directly back into the probe tip and sent to the display screen. When held oblique to the area imaged, part of the echo is reflected away from the probe tip and less is sent to the display screen. On A-scan, the greater the perpendicularity, the more steeply rising the spike is from baseline and the higher the spike. On B-scan, the greater the perpendicularity, the brighter is the dots on the surface of the area of interest. The size and shape of the surface at each interface also affect that reflection.

Absorption

Ultrasound is absorbed by every medium through which it passes. The denser the medium, the greater is the amount of absorption. This means that the density of the solid lid structure results in absorption of part of the sound wave when B-scan is performed through the closed eye, thereby compromising the image of the posterior segment. By performing on the open eye, the patient is also now able to look in extreme down gaze, which is impossible when the eye is closed and rotated upward.

When calcification of tissue is present, there is so much absorption and such a strong reflection of the echo back to the probe that there is no signal posterior to that medium. This is referred to as shadowing

Velocity

The velocity of the sound wave is dependent on the density of the medium through which the sound travels. Sound travels faster through solids than liquids, an important principle to understand since the eye is composed of both. There are known velocities of different components of the eye, with sound traveling through both aqueous and vitreous at a speed of 1,532 meters/second (m/s) and through the cornea and lens at an average speed of 1,641 m/s.

Reflectivity

When sound travels from one medium to another medium of different density, part of the sound is reflected from the interface between those media back into the probe. This is known as an echo; the greater the density differences at that interface, the stronger the echo, or the higher the reflectivity.

In A-scan ultrasonography, a thin, parallel sound beam is emitted, which passes through the eye and images one small axis of tissue; the echoes of which are represented as spikes arising from a baseline. The stronger the echo, the higher is the spike. For example,

the vitreous is less dense than the vitreous hyaloid, which in turn is much less dense than the retina. Therefore, the spike obtained as

the sound strikes the interface of the vitreous and hyaloid, is shorter than the spike obtained when the sound strikes the hyaloid-retinal interface.

In B-scan ultrasonography, an oscillating sound beam is emitted, passing through the eye and imaging a slice of tissue; the echoes of which are represented as a multitude of dots that together form an image on the screen. The stronger the echo, brighter is the dot. Using the same example, the dots that form the posterior vitreous hyaloid membrane are not as bright as the dots that form the retinal membrane. This is very useful in differentiating a posterior vitreous detachment (a benign condition) from a more highly reflective retinal detachment (a blinding condition).

Scattering occurs from irregular surfaces like ciliary body and small clumps of cells resulting in weaker echoes even if the incident beam is perpendicular.

Ultrasound passing through a medium is absorbed and converted into heat. This is very minimal in diagnostic ultrasound.

TRANSDUCER

It is a device that converts energy in one form into another. The ultrasound pulses are generated by peizo electric crystals like quartz or ceramic crystals, located near the probe

face, within the transducer. When stimulated by the electric current these vibrate mechanically and produce ultrasound energy. During the pause in between the pulses, the echoes from the tissues strike back at the crystals

causing them to vibrate in a reverse fashion. These vibrations are changed into electrical stimuli which then undergo complex signal processing to be finally displayed on the screen in either of the two modes: A scan or B scan. A stationary transducer is used for A scans and a larger, oscillatory transducer for B scan. The ultrasound waves generated by the transducer can be emitted as parallel or a focused beam.

PARALLEL BEAM VS FOCUSSED BEAM

Parallel beam is generated by a planar crystal used in the probe. It is used in A scan. The parallel beam from a planar crystal can be focused using an acoustic lens. It is used in B scan probe. A focused beam gives better lateral resolution than a parallel beam.

SIGNAL PROCESSING

The echoes received by the transducer undergo complex signal processing including Amplification, compensation, compression, demodulation, rejection etc. Each manufacturer may use different ways of signal processing causing different appearance of echoes on the screen for the same lesion. This discrepancy led to the development of standardized A scan.

Amplification Is the part of signal processing. This can be done on three ways:

linear amplification, logarithmic amplification or S shaped amplification.

Range is the difference between maximum and minimum echo intensities that can be displayed by the instrument. Like resolution the type of amplifier used also affects it.

Linear amplification gives better resolution but range is comparatively less. For logarithmic amplification range is large but resolution is less, 'S' amplification combines both the properties of linear amplification and helps in better tissue differentiation. This type of amplification is used in standardized instruments.

Gain is the adjustment of amplification of echoes that can be done by the examiner and is measured in decibels. Higher the gain, greater the sensitivity of the instrument in displaying weaker echoes but lesser the resolution. Lowering the gain improves both axial and lateral resolution but decreases sensitivity

DISPLAY

A scan is a one dimensional display of echoes as vertical spikes from a baseline. The height or the amplitude of the spikes gives rise to the term A scan (A for amplitude). The distance between the two spikes is dependent on the time taken by sound to reach an interface and for the echo to return to the probe.

B scan displays a 2 dimensional acoustic cut section. Gray scale incorporated in the instrument depicts the intensity of the echoes by the intensity of the dots.

Field of view with B scan at any time is 45deg to 60 deg depending on the oscillation of the transducers used in the machine.

STANDARDISED A SCAN

This has 3 unique features

1. An amplifier with specific characteristics
2. Unique frequency probe and beam shape
3. A tissue model for determining tissue sensitivity

The 'S' amplifier used in standardized A units was developed by **Ossoinig**. In this amplifier there are precise values which determine how the echoes will appear on the screen for a given lesion. Additionally, these values are exactly the same from one standardized instrument to the other. This helps to classify the reflective spikes and aid in different diagnosis.

Frequency of a standardized A scan probe is always 8 MHz where as most biometric A scan probes have frequencies ranging from 8-10 MHz.

Tissue model is a small metal canister containing a transparent, rubbery substance in which tiny glass beads are suspended. When the A scan probe is kept on this model echoes are produced and the gain of the unit is adjusted to produce a specific pattern. The value of

the gain producing this specific pattern is called tissue sensitivity.

INDICATIONS AND EXAMINATION TECHNIQUES

INDICATIONS

Echography is the important method of evaluating an eye with opaque media. This along with history and clinical findings help to arrive at a proper diagnosis

The opaque media can be classified as

1. **Anterior Segment**

- Opaque cornea
- Hyphema and Hypopyon
- Cataract
- Pupillary and retrolenticular membrane

2. **Posterior Segment**

- Vitreous Hemorrhage
- Vitreous opacities and membranes

Other indications include miosis, intraocular tumor evaluation, axial length measurement and in evaluation of proptosis.

EXAMINATION TECHNIQUES

Depending on whether the posterior segment alone or posterior segment combined with anterior segment examination is needed a contact method or immersion technique may be used. In contact method probe is placed directly over the globe. In our hospital contact method employing B scan is alone used for diagnosis of posterior segment disorders.

B Scan Technique

Construction of a 3 dimensional mental picture from the 2 dimensional displays is the key to success with B scan.

B scan is the primary modality for determining lesion topography- location and configuration of the lesion. By obtaining echogram in different positions, the echographer constructs a mental three dimensional picture of lesion topography.

The probe face is always represented by the initial line on the left side of the display screen. The fundus of eye located on the side of globe opposite to where the probe is positioned, is represented on the right side. The upper part of the echogram corresponds to the portion of the globe where the probe marker is directed. Methyl cellulose is used as

coupling medium. Probe is placed directly on the cornea or conjunctiva.

Probe positioning

Three basic B scan probe orientations are

1. Transverse
2. Longitudinal
3. Axial

Transverse probe positions

The transverse probe position most commonly is used. This technique demonstrates the lateral extent of the pathology and encompasses approximately 6 clock hours. Because of the area covered, this orientation is used for basic screening examinations when there is no view of the posterior segment.

With the eye anesthetized, the patient should be instructed to look in the direction of the area of interest. The probe face is positioned on the opposite scleral surface parallel to the limbus, regardless of probe location around the globe, with the marker aimed either superiorly or nasally. Consequently, the marker is oriented superiorly when examining the nasal or temporal globe (3-o'clock or 9-o'clock positions) and towards the nose when

examining the superior or inferior globe (12-o'clock or 6-o'clock positions).

Longitudinal probe positions

Longitudinal probe positions represent the radial extent. Longitudinal scans demonstrate only 1 clock hour per echogram radially, but that clock hour is represented from the posterior pole out to the anterior equator or ora serrata. This technique is an adjuvant to the transverse probe examination in many situations but most importantly for intraocular tumors and retinal tears. The transverse probe position assesses the lateral width of an intraocular tumor, whereas the longitudinal probe position evaluates the radial extent and the proximity to the optic nerve. Because the flap of a retinal tear is directed radially toward the posterior pole from the periphery, a longitudinal scan is the only way to image the flap. When a tumor is being measured, the height can be measured on either a transverse scan or a longitudinal scan, but the width of the lesion must be measured in both the lateral direction and the radial direction so that the largest width can be detected for treatment (e.g., determining radiation plaque size). As with transverse scans, the patient is instructed to look in the direction of the area of interest, and the probe face is placed on the opposite scleral surface. The probe face is rotated so that it is the echogram rather than the macula. The patient must be perpendicular to the limbus, with the marker directed toward the limbus, or toward the area of interest, regardless of the clock hour being examined. This results in the optic nerve shadow being represented at the bottom on the right side

of each longitudinal echogram, and the posterior pole just above the nerve shadow. The anterior portion of the clock hour is represented at the top of the right side. The designation of the longitudinal scan is simply the clock hour being examined followed by an "L."

A limbus-to-fornix approach should be used in longitudinal scanning to adequately center the pathology into the area of best resolution.

Axial probe positions

In A-scan biometry, this term is used for the measurement of the length of the eye along the visual axis, or through the vertex of the cornea, center of the lens, and the center of the macula. In B-scan echography, the term axial refers to the centering of the posterior lens curve to the left of the echogram and the optic nerve shadow to the right of looking in primary gaze, and the probe should be centered on the corneal vertex. Because the optic nerve inserts into the globe just nasal to the macula, the probe should be tilted to aim the sound beam slightly nasally to image the nerve in the right center of the echogram. The orientation of the marker depends on the desired meridian. Because the ultrasound slice is emitted from the probe tip in the direction of the longest oval of the probe face along the line of the marker, any clock hour can be imaged in the upper and lower quadrants of the right side by changing marker orientation.

Note that because the sound is now traveling through the lens, some absorption will occur, compromising the fundus image. If an intraocular lens is present on axial scanning, artifact reverberations will occur in the vitreous cavity, as with A-scan biometry.

A **horizontal** axial scan is accomplished by rotating the marker to aim toward the nose, or the 3-o'clock position for the right eye or the 9-o'clock position for the left eye. This results in the slice cutting through the nerve horizontally, with the nasal meridian (i.e., 3-o'clock position right eye, 9-o'clock position left eye) at the top of the right side, and the temporal meridian (ie, 9-o'clock position right eye, 3-o'clock position left eye) at the bottom. This is the most useful axial scan for basic screening purposes because the nerve and macula are both in the display. Because the macula is located just temporal to the optic nerve, the macula is located just inferior to the nerve shadow on the echogram.

Rotating the marker superiorly toward the 12-o’clock position in either eye produces a vertical axial scan. The slice will now cut through the nerve vertically with the 12-o'clock position at the top on the right and the 6-o'clock position at the bottom in either the right or left eye.

For **oblique** axial scans, the marker is rotated to include the clock hours desired. If the meridian desired is located below midline, the marker should be

oriented opposite that meridian. For example, if the desired meridian is a tumor at the 11-o'clock position, rotate the marker toward the 11-o'clock position, and the tumor will appear in the upper-right of the scan, with the 5-o'clock position at the bottom, below the nerve. However, if the tumor resides at the 5-o'clock position, the marker should be rotated toward the 11-o'clock position, and the 11-o'clock position will appear at the top-right of the scan, with the 5-o'clock position tumor below the nerve, at the bottom

Basic B scan Examination

Basic screening refers to an examination performed when there is no view into the eye because of opaque media, such as corneal edema or scarring, extremely dense cataracts, or vitreous hemorrhages, and the determination of the status of the posterior segment is required. In these cases, the highest gain setting must be used to visualize any weak signals, such as vitreous opacities and posterior vitreous detachments, or to gauge the extent of vitreous hemorrhages. If any pathology such as retinal or choroidal detachments is found, then the gain may be reduced for better resolution of the stronger signals from these structures once the basic screening is completed and documented.

Technique

Using a limbus-to-fornix approach, each quadrant is evaluated carefully. The 4 major quadrants include the 12- o'clock, 3-o'clock, 6-o'clock, and 9-o'clock positions, each centered on the right side of the echogram in transverse approaches. Because approximately 6 clock hours are imaged at once, by examining each quadrant, the areas examined will overlap, thereby reassuring the examiner that the entire periphery of the globe is visualized. A photo or printed documentation of each of the 4 quadrants should be obtained. Next, document the posterior pole with a horizontal axial scan, which incorporates both the optic nerve and the macula in one echogram. If no additional pathology is detected, these 5 echograms complete the examination.

Centering pathology found during basic screening

If any posterior pathology is detected during basic screening, it should be centered on the right side of the echogram to achieve greatest resolution. This is accomplished by determining the clock hour represented in the center, top, and bottom of the right side on the transverse scan where it was discovered, and then determining where this pathology lies in relation to those clock hours. Once determined, the patient should be instructed to redirect his or her gaze to that meridian, with the probe then placed on the opposite scleral surface.

Perpendicularity to the pathology is achieved when it is centered and when the vertex of the pathology is a brighter white. The gain is now reduced until the greatest resolution is achieved, and photographic documentation is produced with proper labeling.

Additional scans may be required, such as longitudinal scans to document the radial aspect of the pathology, axial scans to document location of the pathology from the optic disc, and diagnostic A-scans for tissue differentiation.

Localization of the macula

The 4 methods of localizing and centering of the macula are as follows: horizontal, vertical, transverse, and longitudinal. Depending on the eye, one method may be preferable to another, or a combination of methods may be desired.

The horizontal method involves placing the probe on the corneal vertex with the marker nasally, as with a horizontal axial scan; but, rather than tilting to center the nerve, the probe should be aimed straight ahead to center the macula. The nerve shadow will now shift upward slightly, and the macula will be centered to the right of the echogram, with the posterior lens surface centered to the left. These scans should be labeled HMAC.

The vertical method involves placing the probe on the corneal vertex, but the marker is in the 12-o'clock position. The probe should be aimed straight back to center the macula.

The nerve will not appear in these scans because this is a vertical (instead of horizontal) slice of the macula. These scans should be labeled VMAC.

The transverse method involves the patient fixating slightly temporally and placing the probe onto the nasal sclera with the marker at the 12-o'clock position. Using the optic nerve as the center of the imagined clock, the macula is at the 9-o'clock position at the posterior pole in the right eye and at the 3-o'clock position at the posterior pole in the left eye. This scan bypasses the lens, thereby preventing absorption or reverberation artifacts from an intraocular lens. These scans should be labeled TMAC.

The longitudinal method involves directing the patient's gaze slightly temporally, with the probe on the nasal sclera and the marker oriented toward the limbus or temporally toward the macula. This is a horizontal scan of the macula, with the nerve at the bottom-right of the echogram and the macula just superior to the nerve, with the lateral rectus muscle visible coursing through the orbit. These scans should be labeled LMAC. Because the nerve and the macula are imaged, the

longitudinal method may be preferable if the patient has a cataract or intraocular lens in place.

Anterior segment Examination

Immersion technique

Because the area of best resolution is in the center on the right side of an echogram, examining the anterior segment with a standard 10 MHz contract probe can be accomplished only with the use of a scleral shell. This shifts the anterior segment to the right and into the area of focus of the sound beam, improving resolution of anterior segment pathology. The shell is filled with methylcellulose or some other viscous solution to a meniscus, avoiding air bubbles within the shell. The probe is placed on top of the shell. This produces an echolucent area on the left side of the echogram corresponding to the shell and methylcellulose, and it shifts the anterior segment to the right side of the display screen.

With immersion B-scan, the patient looks opposite the pathology to center the area of interest directly under the shell. Diagnostic A-scan also can be performed through the shell, directly over the lesion, for tissue differentiation.

High-resolution technique

High-resolution B-scan probes have been developed for higher quality imaging of

the anterior segment. These high-resolution probes range from 20 MHz to 50 MHz, with penetration depths of about 10 mm to 5 mm, respectively; therefore, they may be used only for imaging the anterior segment of the eye.

These probes may have an external oscillating transducer and can be placed in a special scleral shell, although great care must be taken so that the probe never slips into the shell far enough for the transducer to come in contact with the cornea as it oscillates. Another method is to slip a small handheld pen-type tonometer cover over the tip of the probe and fill it with tap water to form a protective layer of water between the transducer and the patient's eye. By placing a small amount of methylcellulose on the vertex of the cover for sound conduction, the tip of the cover rests on the eye directly over the pathology for imaging. Care should again be taken not to push hard enough against the eye for the transducer to contact the eye.

For both immersion and high-resolution imaging of the anterior segment, the marker is oriented as with contact scanning for transverse and longitudinal cuts.

Basic A scan Examination

It is done using standardized A scan unit, scanning is done in at least eight meridians starting from the 12 o’ clock meridian. Patient’s gaze is always directed towards the meridian being examined. As with Bscan the probe is initially placed near the limbus to

scan the posterior part of the meridian and then moved into the fornix to scan the anterior part.

At tissue sensitivity gain setting even very low echoes is picked up. But resolution is poor and so very thin lesions of the fundus may be missed. In order to overcome this possibility the procedure is repeated at a lower sensitivity setting (tissue sensitivity -24dB) observing the distance between retinal and intrascleral spikes and also taking note of any abnormal preretinal spike that may appear. If the distance between the retinal and intrascleral spikes is greater than 2 microseconds (1.5mm), it is abnormal indicating thickening of retinochoroidal layer.

Special Examination Techniques

Differential diagnosis of intraocular lesion detected on basic screening is done by special examination techniques devised by Ossionig. These techniques include:

- Topographic Echography which gives location, extenson and shape of the lesion can be done with both A and B scans.

- Quantitative Echography which estimates the reflectivity (spike height), internal structure (histological architecture) and sound attenuation.
- Kinetic evaluation which gives the mobility (after movement) and vascularity(blood flow) of the lesion

<u>Topographic Echography</u>

B scan is ideal for this examination. After general localization with B scan, Ascan at tissue sensitivity setting is done with the probe placed first in the meridian of the centre of the lesion. The probe is then moved to get the anteroposterior and lateral extent of the lesion. These maneuvers help to classify the lesion as:

a. Point like - Foreign body, vitreous opacities

b. Membrane like - RD, PVD, Choroidal detachment, Vitreous membranes, and Tumor surfaces

c. Mass Like - Melanoma, RB, Haemangioma etc

They also help to define its location and extent.

Quantitative Echography

It is of two types –

Type-I

This is done to determine the reflectivity and sound attenuation of a lesion for differential diagnosis. Reflectivity is evaluated by spike height in A scan and

signal brightness on B scan. The sound beam is directed perpendicular to the lesion and from different directions. Membranes, bands, opacities, foreign bodies and tumors can be differentiated with the help of type 1 quantitative echography. The reflectivity of tumors correlates with their histologic structure.

On A scan, vitreous baseline represents 0% reflectivity and top of initial spike as

reflectivity at tissue level. Reflectivity of any lesion is expressed as a percentage of this spike and is interpreted by comparison with standard patterns.

The standard patterns of Reflectivity is usually classified as

Extremely Low	0-5%	Vitreous degeneration, long standing dispersed vitreous hemorrhage
Low	5-40%	Recent Vitreous hemorrhage
Medium	40-60%	Melanoma
Medium-High	60-80%	Organized vitreous hemorrhage
High	80-100%	Organized vitreous hemorrhage- metastatic carcinoma and Choroidal hemangioma
Very High	!00%	Retinal detachment, Junius-Kuhnt lesion, Retionblastoma Intraocular foreign body

B scan does not provide a standardized gain setting as in the standardized A unit. So the examiner should be cautious in judging the reflectivity from the signal brightness on B scan.

In case of a mass lesion reflectivity determination helps in evaluating its internal structure and sound attenuation

Internal structure

This refers to the degree of uniformity of internal echoes and correlates with the histological appearance of the tumor.

Regular internal structure is represented by little or no variation in height and length of spikes on A scan and a uniform brightness of echoes on B scan. Histologically these have a homogenous appearance.

Irregular Internal structure is represented by varying heights and lengths of internal spikes and correspond to the irregular arrangement of tumor cells interspersed with vascular and fibrous elements, hemorrhage and necrosis.

Sound Attenuation

Occurs when sound energy is scattered, reflected or absorbed by a given medium. It occurs when examination is done through edematous lids, extremely dense opacities and membranes or a medium that produces extremely high reflectivity e.g. calcium

On A scan, the decreasing spike height is measured by 'angle kappa' which

is determined by drawing an imaginary line through the peaks of the lesion spikes to touch the vitreous base line. Steeper the angle, steeper is the sound attenuation. On B scan there is a decrease in signal behind the lesion which is called shadowing.

Type- II

This is used primarily to differentiate Retinal Detachment from dense vitreous membranes. It is applied if a membrane like lesion produces 100% spike reflectivity at tissue sensitivity

gain setting during quantitative type I assessment and the other acoustic characteristics are equivocal. Type II echography allows precise measurement of a membrane's reflectivity in decibels as compared with reflectivity of the sclera in the same eye. The difference in decibels between the lesion spike and scleral spike (db) helps the examiner to determine the quantitative characteristics of the membranes in question.

Kinetic Echography

Mobility and vascularity are evaluated.

Lesion Mobility

B scan is used to assess the gross mobility of vitreous opacities and membranes. After movement is evaluated before, during and immediately following an eye movement. A scan also can detect subtle motion of a lesion. Spike after movement may be classified as horizontal or vertical. Horizontal spike

motion is a lateral movement of spike along the baseline, corresponding to lateral motion of the lesion. Vertical spike motion is a change in spike height caused by a minimal change in position of a lesion relative to the sound beam. This slight after movement may not be appreciable with B scan.

Vascularity (Spontaneous Motion)

This is detected on A scan as low amplitude flickering of internal lesion spikes. This may also appear as varying brightness of the dots in B scan. This phenomenon helps in

characterizing tumors.

ULTRASOUND CHARACTERISTICS OF COMMON LESIONS

VITREOUS

In a young healthy eye, the vitreous is relatively echolucent. However, as the eye ages, the vitreous undergoes syneresis, and low reflective vitreous opacities can be

detected. A posterior vitreous separation (a benign condition of the aging eye) may occur and is represented as a mobile, fine thin, low reflective echo. Asteroid hyalosis can be detected with ultrasound .The calcium is relatively dense and, therefore, produces multiple pinpoint, highly reflective vitreous opacities.

Vitreous hemorrhage can occur in several different situations, such as after trauma or a retinal tear or as a complication of diabetes mellitus or a retinal vein occlusion. The echographic pattern of a vitreous hemorrhage depends on its age and severity. Fresh mild hemorrhages appear as small dots or linear areas of low reflective mobile vitreous opacities, whereas in more severe older hemorrhages, blood organizes and forms membranes. The membranes form large interfaces that are visualized echographically as a vitreous filled with multiple large opacities

that are higher in their reflectively. Vitreous hemorrhages may also layer inferiorly due to gravitational forces.

Membrane formation also can occur after trauma, particularly after penetrating or perforating eye injuries. A membranous track often develops along the path of the offending object. In penetrating injuries, this track may end in the vitreous cavity or at an impact site opposite the entry site. In perforating injuries on B-scan, the track spans the eye from the entry site to the exit site. Therefore, following the track may lead to an intraocular

foreign body and/or retinal pathology at an impact or exit site. Intraocular foreign bodies can be detected easily with ultrasound. Even if already detected with some other imaging modality, such as computerized tomography or magnetic resonance imaging, ultrasound can more precisely localize the foreign object. This can be extremely vital information because it can determine how the surgeon approaches the case.

RETINA

A retinal tear can be detected with ultrasound when using longitudinal approaches. On occasion, retinal tears are accompanied by vitreous hemorrhages, which preclude visualization of the etiologic tear. In such instances, one often can

see the posterior vitreous hyaloid or a vitreous strand attached to the retinal flap .

These tend to occur in the far periphery, where the vitreous is most firmly attached to the retinal surface, particularly superotemporally. A shallow cuff of subretinal fluid may accompany the tear and make the diagnosis more evident.

When a retinal detachment is present, the examiner sees a highly reflective, undulating membrane. In patients with total retinal detachments, the typically folded surface attaches to the ora serrata anteriorly and the optic nerve posteriorly . Initially, a

retinal detachment is relatively mobile (with eye movement). However, with time, proliferative vitreoretinopathy (epiretinal membrane formation) can occur, and the retina becomes stiffer and takes on more of a funnel configuration.

Retinoschisis is a condition where there is a split between specific layers of the retina. Clinically, differentiating a retinoschisis from a retinal detachment is difficult. Ultrasound can further assist in the differentiation because retinoschisis is more focal, smooth, dome-shaped, and thin.

B-scan ultrasonography commonly is used for the initial and follow-up evaluation of retinoblastoma. Retinoblastoma, a highly malignant retinal cancer

found in infants and young children, commonly has focal areas of calcification within the tumor. Ultrasound can easily detect the calcium, represented as highly reflective foci within the tumor or vitreous. When small, the tumors are smooth; dome shaped, and is low to medium in internal reflectivity. As the tumors grow, they become more irregular in configuration and more highly reflective as the amount of calcium accumulates. This pediatric cancer can be unilateral and unifocal, unilateral and multifocal, or bilateral. Ultrasound has become a very useful and very cost effective way to follow these tumors as treatment is delivered. Baseline tumor size measurements and tumor locations are obtained, and these parameters are monitored closely during and after treatment.

Typically, the presence of leukocoria (a white pupil) alerts the parent or the pediatrician to this disease. However, multiple other pediatric retinal diseases are associated with leukocoria, such as persistent hyperplastic primary vitreous (PHPV), retinopathy of prematurity (ROP), Coats disease, and medulloepithelioma. PHPV, also called persistent fetal vasculature (PFV), is almost always a unilateral condition where the primary vitreous (particularly the hyaloid vessel) fails to regress and continues to extend from the optic nerve to the posterior lens capsule. Echographically, one can detect the very thin persistent

hyaloid vessel coursing from the disc to the lens when longitudinal approaches are used . Other echographic features may include a retrolental membrane, a small globe (small axial length), and, in severe cases, an associated traction or total retinal detachment.

ROP is a bilateral disease that may be asymmetric in its severity but is commonly quite symmetric. There are various stages of this disease; however, the most advanced stage (stage V) often has a white pupillary reflex. Stage V disease is defined as a total retinal detachment due to peripheral contraction of fibrovascular proliferative tissue and commonly has a funnel configuration. The configuration of this detachment is detected easily with ultrasound.

Coats disease is a unilateral condition characterized by retinal vascular telangiectasia

and, when severe, an exudative retinal detachment. This disease can be the most difficult to differentiate from retinoblastoma. However, ultrasound is very useful because of the lack of calcium and the presence of cholesterol in the subretinal space. In the areas of telangiectasia, the retina is commonly thickened.

A medulloepithelioma is a rare tumor that primarily arises in the ciliary body of children. Typical ultrasound features include a dome-shaped configuration, high internal reflectivity, moderate vascularity, and multiple cystic spaces.

CHOROID

Echographically, the choroid is much thicker than the retina. When the retina and choroid are still apposed, one can see a double spike on diagnostic A- scan, a highly reflective spike representing the vitreoretinal interface, and a slightly less reflective spike representing the retinochoroidal interface. A choroidal detachment may occur spontaneously, after trauma, or following a variety of intraocular surgeries. On ultrasound, the detachment is smooth, dome-shaped, and thick. Virtually no movement is seen with eye movement. When extensive, one can see multiple dome-shaped detachments, which may "kiss" in the central vitreous cavity. When choroidal detachments are hemorrhagic rather than serous (as commonly seen in traumatic situations), the subchoroidal space is filled with a multitude of dots in contrast to the echolucent subchoroidal space of a serous

choroidal detachment.

The most common tumor of the choroid is malignant melanoma. Although these can arise in the ciliary body or iris, they most commonly are seen in the choroid. Like retinoblastoma, ultrasound has become invaluable in the diagnosis and follow-up evaluation of uveal malignant melanomas. This homogenous highly cellular tumor results in low-to-medium internal reflectivity and regular internal structure.

A nearly pathognomonic finding is a collar button configuration (ie, mushroom shape), but this shape is seen in less than 25% of cases. Histologically, the collar button represents the portion of the tumor that has broken through the Bruch membrane, a basement membrane found between the choroid and the retina. Typically, a choroidal melanoma has a smooth, dome shape. Diffuse melanomas have a relatively flat shape and an irregular contour but maintain low-to-medium internal reflectivity.

When a portion of a melanoma outgrows its blood supply, that portion of the tumor may necrose and bleed internally, or into the subretinal, vitreous, or suprachoroidal space. If the hemorrhage is extensive, the blood may prevent echographic detection of the tumor. In such cases, follow-up examination is vital. When the tumor bleeds internally, the examiner may see highly reflective pockets within the tumor and a consequently irregular internal structure. Since larger melanomas produce significant internal sound attenuation,

there is a lower reflectivity at the base of the tumor, which is referred to as acoustic hollowing.

Occasionally, choroidal evacuation is seen at the base of the tumor. This is believed to represent the tumor invading the deeper choroidal structures. A melanoma can progress further and extend through the scleral wall, referred to as extrascleral extension. This usually occurs along emissary canals.

Ultrasound is probably the only reliable method of detecting small posterior extrascleral extensions.

Such information is critical to management decision making and prognosis. If a melanoma is treated with brachytherapy, intraoperative echographic localization of the plaque in relation to the tumor has significantly improved treatment success. Finally, if eye-sparing treatments can be performed, such as brachytherapy, proton beam irradiation, or transpupillary thermal therapy, ultrasound is invaluable in monitoring the tumor response in both size and internal reflectivity. A favorable response is a progressively regressing tumor with increasingly higher internal reflectivity. Obviously, an unfavorable response is a tumor that continues to grow.

Benign melanocytic tumors include nevi and melanocytomas. Like a melanoma, the

pigmentation of a nevus can range from no pigmentation (amelanotic) to a deep brown pigmentation (melanotic). A melanocytoma typically is heavily pigmented. They, too, have a dome-shaped configuration but, in contrast to melanoma, are highly reflective and do not have internal vascularity. Unfortunately, small melanomas may show an absence of low internal reflectivity, and, consequently, it may be difficult to differentiate a small benign lesion from a similar sized malignant one.

Metastatic tumors can spread to the choroid due to its highly vascular nature. These tumors have a much different echographic appearance. Clinically, these tumors are creamy or yellow in color and multilobulated. Echographically, these tumors usually have an irregular lumpy contour, an irregular internal structure, a medium-to-high internal reflectivity, and little evidence of internal vascularity. Although exudative detachments occur with uveal melanomas, similar sized metastatic tumors generally have more extensive detachments. Extrascleral extension also can be seen with these tumors and, therefore, is not helpful in the differentiation of the tumor.

Choroidal hemangioma is a benign vascular tumor of the choroid. These tumors can produce localized exudative retinal detachments and subsequent vision loss. Clinically, these tumors are orange dome-shaped tumors. Echographically, a choroidal hemangioma is dome-shaped and has a high internal reflectivity. An overlying serous retinal detachment can be seen with B-scan. A more diffuse form of a choroidal hemangioma is seen in

Sturge-Weber syndrome. In these patients, the tumor is more extensive and less elevated.

Calcific choroidal tumors are easily differentiated and detected with B-scan. A choroidal osteoma clinically appears as a yellow lesion, commonly located near the optic nerve. These tumors are not significantly elevated. On ultrasound, they

have very high internal reflectivity due to the calcium. Their contour is usually flat and smooth, but, on occasion, these tumors are lumpy in appearance. Marked shadowing occur posterior to the tumor due to the calcium absorbing the sound energy.

CILIARY BODY

The ciliary body is visualized best with high-resolution scanning; however, the immersion method may be used, or even the contact method can be used to evaluate the more posterior aspects of the ciliary body. A ciliary body detachment can extend into the peripheral choroid and can be seen on contact B-scan, although it is displayed best on high-resolution scanning. A low-to-medium reflective cleft is seen in the subciliary space

Ciliary body tumors are similar to those seen in the choroid. The most common ciliary body tumors are melanomas; however, a variety of other tumors do arise in the ciliary body, including metastatic tumors, medulloepitheliomas, and leiomyomas.

SCLERA

Diagnostic ultrasonography is probably the best way to evaluate scleral thickening. Scleral thickening occurs in cases of nanophthalmos (very small eyes), ocular hypotony, phthisis bulbi, and scleritis. In scleritis, the degree of scleral thickening can vary from mild to severe, and it can be focal or diffuse. Commonly, associated edema adjacent to the sclera is present. This manifests itself as an echolucent area in the Tenon space. When posterior and adjacent to the optic nerve, it forms a T-sign. Other associated findings include a thickened highly reflective sclera, retinal detachments, and ciliochoroidal detachments.

Patients who are myopic may have focal areas of thinning sclera. These areas can form staphylomas, or out-pouching. Ultrasound is the best imaging modality for staphylomatous changes. In trauma, occult scleral ruptures can be difficult to appreciate on clinical examination. Ultrasound typically cannot detect the actual rupture; however, several echographic clues can assist the clinician. These clues include hemorrhage in the immediate episcleral space, a thickened or detached choroid, a detached retina in the area of concern, vitreous hemorrhage, or vitreous incarcerated into the rupture.

OPTIC NERVE

Optic disc cupping usually can be seen on clinical examination. However, if media opacities prevent examination, the contour (including the degree of cupping) can be detected with ultrasound. Similarly, optic nerve colobomas are imaged easily with ultrasound.

When seen clinically, differentiating papilledema (optic disc edema) from pseudopapilledema is critical since the former is associated with elevated intracranial pressure, while the latter may have no systemic relevance. Optic disc drusen are calcific nodules buried within the optic nerve head and can simulate papilledema. On ultrasound, these nodules are highly reflective and exist at or within the optic nerve head. In true papilledema, increased intracranial pressure (ICP) is transmitted along the subdural space within the optic nerve. Clinical entities that can cause elevated intracranial pressure include pseudotumor cerebri and intracranial tumors. When the ICP is mildly elevated, the optic nerve is slightly widened. In the more severe cases, one can see an echolucent circle within the optic nerve sheath (separating the sheath from the optic nerve). This is the so-called crescent sign

The presence of increased fluid within the sheath is confirmed best with the

30-degree test, which is a dynamic A-scan test that measures the width of the optic nerve in primary gaze and again after the patient shifts gaze 30 degrees from primary. In cases of increased ICP, the nerve and sheath are stretched as the globe turns 30 degrees, and the subarachnoid fluid is distributed over the extent of the nerve, resulting in measurements less than when in primary gaze. If nerve enlargement is due to parenchymal infiltration or thickening of the optic nerve sheath, then the measurement will not change as the globe turns from primary.

An optic nerve glioma is a neoplastic process that infiltrates the optic nerve parenchyma. On ultrasound, this is a smooth, fusiform mass with low-to-medium and regular internal reflectivity. An optic nerve sheath meningioma is an example of a tumor of the optic nerve sheath. In contrast to a glioma, this neoplastic process typically has a medium-to-high, irregular internal reflectivity with possible areas of calcification

TRAUMA

1. Intraocular Foreign bodies (IOFB)

Echography is a valuable complement to X rays in the detection of foreign bodies. It aids in precise localization of the foreign body. A scan shows a high (100%) spike with a string of reduplication echoes.

Quantitative echography showing +/-6dB reflectivity when compared to scleral reflectivity is almost diagnostic. Other point like echoes 6-20 dB weaker than scleral echoes showing sound attenuation and shadowing of orbital tissues and having magnetic properties are also diagnostic of foreign bodies.

Mural foreign bodies are difficult to diagnose and is best accomplished by a standardized A scan. A foreign body echo can be obtained if it is centered in the ultrasound irrespective of the angle at which the beam strikes the foreign body, while the sclera cannot be defined unless it is struck by a beam perpendicular to it.

The size of the intraocular foreign body cannot be made out on ultrasonogram. Very small foreign bodies (less than 0.5mm) may not show after echoes even though they may be highly reflective. Penner and Passmore studied the ultrasonic differentiation of magnetic and non magnetic foreign bodies. According to them if a weak pulsating electromagnet initially held a few feet away from the injured eye is slowly brought towards it, the echoes of the foreign body being still observed, the scan shows slight decrease in spike height due to the tilt of the foreign body as it tries to align itself in the magnetic field. Depending on the distance at which this response occurs, decision can be made whether to extract the foreign body with a magnet or not. Other than the magnetic test ultrasound is of no value in determining the composition of a foreign body.

Intraocular air bubble echoes are as intense as those from metal. However because air bubbles are spherical and smooth they produce echoes of similar appearance when evaluated from different probe positions. For intraocular foreign bodies varying signals in different probe positions are obtained.

2. **Posterior Segment Lesions**

Caused by blunt or penetrating trauma these include vitreous hemorrhage, retinal detachment, retinal dialysis, retinal edema and posterior scleral rupture. Posterior scleral rupture presents with marked hemorrhagic chemosis and vitreous hemorrhage with normal IOP. On echography, the sclera in the area of rupture may show a moderately irregular contour and decreased reflectivity. Actual split in the sclera is not usually made out. There may be other associated findings which point to the presence of scleral rupture.

These include

- Vitreous incarceration into the fundus associated with vitreous hemorrhage and posterior detachment.
- Thickening or detachment of surrounding retina and choroids

- Hemorrhage in the immediate episcleral space. The incarcerated vitreous may show traction bands or folds that extend across the vitreous cavity towards the site of incarceration.

ENDOPHTHALMITIS

On A scan clinically evident endophthalmitis produce a chain of low amplitude spikes within the vitreous. On B scan these appear as diffuse fine dots. If the source of infection is anteriorly located, opacities are initially denser anteriorly. If PVD has not occurred prior to endophthalmitis, it usually remains attached, probably due to inflammatory adhesions between vitreous and retina. Tractional or exudative Rd can occur. In early cases doubt may arise whether the vitreous opacities are due to infection or due to vitreous hemorrhage. In hemorrhage the PVD tends to be extensive and opacities are more in the inferior part of the globe due to tendency of the blood cells to migrate inferiorly.

INTRAOCULAR TUMORS

Lesions raised 0.75mm or more from the sclera can be detected. Lesions raised 1.5mm or more are reasonably differentiated based on their consistency and vascularity.

Tumors include retionoblastoma, malignant melanoma metastatic carcinoma and choroidal hemangiomas.

Malignant melanoma shows low to medium reflectivity, no after movement (solid) and fast spontaneous vertical movement indicating vascularity. Sound attenuation is present with thick lesions. Ultrasound usually provides only confirmatory evidence especially if opaque media hinders view. In such cases it helps to differentiate the tumor from hemorrhagic or exudative choroidal detachment.

Metastatic carcinomas are usually multiple, relatively flat lesions with high reflectivity showing little or no vascularity. There is extensive serous detachment of retina adjacent to the metastatic carcinoma. Necrosis causes a decrease in prominence of spikes.

Choroidal hemangioma shows high reflective spikes with no after movement and vascularity even at low settings and variable sound attenuation. There is no growth during follow up in contrast to malignant melanoma.

ARTIFACTS

Artifacts or unwanted echoes are caused by scattering, refraction and reverberations. They can arise from air bubbles which can form in the probe as it ages. It may be present in the coupling gel. In early postoperative cases and traumatized eyes air bubbles can interfere with examination. Reverberations within IOLs cause series of echo one behind the other. Examining the eye in different probe positions will help identify these reduplication echoes.

ULTRASOUND BIOMICROSCOPY

UBM has a very high resolution (20-60 microns) compared to conventional ultrasound (300 -600 microns). This allows us to study anterior eye segment structures as if we are looking at a pathological specimen in vivo through a low power microscope

Since the first experimental report by Pavlin et al in 1990 and the initial clinical application into ophthalmology in 1991, UBM using a 50-MHz frequency transducer has become widely accepted and used to detect a variety of anterior segment disorders. Pavlin et al. presented in 1992 the techniques allowing examination of the filtration angle, sclera thickness and diagnostics of the ciliary body with ultrasound biomicroscopy.

Because of the high frequency of the transducer, however, the penetration depth of

this equipment is limited to 4 mm. Another disadvantage of 50-MHz UBM is that, because the transducer protrudes from the probe, it requires the use of an eyecup during manipulation. The probe is suspended from an articulated arm to reduce motion artifacts, but this restricts the movement of the probe. Esaki et al removed the UBM probe and reattached it to the arm horizontally and upside down for use in the sitting and prone positions, respectively. With this equipment

it is easy to image the anterior segments using the eyecup; however, occasionally, it is difficult to examine the regions of anterior choroid and peripheral retina even when the patient maintains an excellent gaze. It is really difficult to hold the 50-MHz UBM probe stable above the sclera, especially toward posteriorly. With the advent of the newer generation 50-MHz UBM, Gentile et al successfully imaged a variety of disorders of the peripheral retina to pars plana regions using 50-MHz UBM. Liu et al also used 50-MHz UBM for the preoperative assessment of anterior proliferative vitreoretinopathy.

AIM OF THE STUDY

Aim of the study is to highlight the use of ultrasound B scan in diagnosis of posterior segment disorders in presence of opaque ocular media

MATERIALS AND METHODS

100 patients presenting with opaque ocular media referred to the ultrasonography department of Regional institute of ophthalmology Government Ophthalmic hospital, Egmore, Chennai during June 2006 –July 2007 are included in this study.

107 eyes were included in this study. Visual acuity, slit lamp examination and tension were recorded in each patient.

An ultrasonographic unit ‘OTI Scan 1000’ with diagnostic B scan and Biometric A scan was the instrument used.

OBSERVATION AND RESULTS

Patients were divided into age groups with 10 yr intervals

TABLE -1

AGE	No.	%
0-10	13	13%
10-20	17	17%
20-30	17	17%
30-40	10	10%
40-50	18	18%
50-60	12	12%
60-70	08	8%
70-80	05	5%
TOTAL	100	100%

Of the 100 patients studied maximum number was noted in the 40-50 age groups. This accounted for 18% of the total number of patients.

TABLE-2

AGE GROUP 0-10 YEARS

MEDIA	CAUSE	NO.	%
Cornea	2HC	2	12.5%
Anterior Chamber			0%
Lens	6CC;2TC	8	50%
Vitreous	1VH;1RL;4RB	6	37.5%
	Total	16	100

HC-Hazy cornea due to buphthalmos

CC-Congenital cataract

TC-Traumatic cataract

VH-Vitreous hemorrhage

RL-Retrolental fibrous tissue

RBM-Retinoblastoma

Congenital cataract was the common cause for opaque media in 37.5% cases followed by Retinoblastoma in 25% cases. Traumatic cataract followed by buphthalmos was the other common causes noted.

TABLE-3

AGE GROUP 10-20 YEARS

MEDIA	CAUSE	NO.	%
Cornea	5HC; 1GR	6	35.3%
Anterior Chamber	1TH	1	5.9%
Lens	2CC; 1TC	3	17.6%
Vitreous	5VH; 2V	7	41.2%
	Total	17	

HC-Hazy cornea

TH-Traumatic hyphema

GR-Graft rejection

CC-Congenital cataract

TC-Traumatic cataract

VH-Vitreous hemorrhage

V-Vitritis

Trauma causing Hazy cornea (29.4%) and vitreous hemorrhage (29.4%) were the common causes of media opacificaton in this group. Vitritis was noted in 11.8%.

TABLE -4

AGE GROUP 20-30 YEARS

MEDIA	CAUSE	NO.	%
Cornea	2HC; 2AL	4	21%
Anterior Chamber	1TH; 1PE	2	10.5%
Lens	5CT; 3TC	8	42.1%
Vitreous	3VH; 2YR	5	26.4%
	Total	19	

HC-Hazy cornea

AL-Adherent leucoma

TH-Traumatic hyphema

PE-Pupillary exudate

YR-Yellow reflex

CT-Cataract

Cataract was the main media opacification noted in 42.1% of cases with complicated cataract being the more common of the two with 26.3% of the total. The cases with yellow reflex were confirmed to have endophthalmitis.

TABLE -5

AGE GROUP 30-40 YEARS

MEDIA	CAUSE	NO.	%
Cornea	1AL	1	10%
Anterior Chamber	2PE	2	20%
Lens	2CoC; 1CT; 1PCO	4	40%
Vitreous	3VH	3	30%
	Total	10	

AL-Adherent leucoma

PE-Pupillary exudate

CoC-Complicated cataract

CT-Cataract

PCO-Posterior capsular opacification

VH-Vitreous hemorrhage

Lenticular opacification is the most common cause in this group with complicated cataract having 20%. Trauma was responsible for the 30% vitreous hemorrhage noted

TABLE -6

AGE GROUP 40-50 YEARS

MEDIA	CAUSE	NO.	%
Cornea	0	0	0%
Anterior Chamber	1PE	1	5.3%
Lens	2CT; 3CoC; 1PCO	6	31.6%
Vitreous	2YR; 2V; 8VH	12	63.1%
	Total	19	

PE-Pupillary exudate

Vitreous hemorrhage was the common cause with a 66.7% of total cases. Most were due to trauma followed by diabetic retinopathy.

TABLE -7

AGE GROUP 50 -60 YEARS

MEDIA	CAUSE	NO.	%
Cornea	2HC; 1BK	3	23.1%
Anterior Chamber	2HU; 1PE	3	23.1%
Lens	3CT; 1TC	4	30.7%
Vitreous	2VH; 1V	3	23.1%
	Total	13	

HU-Hypopyon uveitis

BK-Bullous keratopathy

Senile cataract was the common media opacity in this group with 23.1% of the total. Vitreous hemorrhage accounted for 15.4% of the total, common cause of which was trauma. Other causes in this group included hypopyon uveitis and bullous keratopathy.

TABLE -8

AGE GROUP 60-70 YEARS

MEDIA	CAUSE	NO.	%
Cornea	1HC	1	12.5%
Anterior Chamber	1TH	1	12.5%
Lens	2CT	2	25%
Vitreous	4VH	4	50%

	Total	8	

Vitreous hemorrhage was the most common cause noted with 50% of total. Most cases were due to diabetic retinopathy closely followed by trauma.

TABLE -9

AGE GROUP 70-80 YEARS

MEDIA	CAUSE	NO.	%
Cornea	0	0	0%
Anterior Chamber	0	0	0%
Lens	2PCO; 2CT	4	80%
Vitreous	1V	1	20%
	Total	5	

Posterior capsular opacification was the common cause of media opacification noted in these cases

TABLE -10

CAUSES OF MEDIA OPACIFICATION

AGE	TRAUMA	INFLAMMATION	OTHERS	TOTAL
0-10	3	2	11	16
10-20	12	2	3	17
20-30	9	5	5	19
30-40	3	4	3	10
40-50	8	8	2	18

50-60	5	4	4	13
60-70	2	1	5	8
70-80	0	1	4	5

Trauma as the cause for media opacification was seen to be maximum in the10-20 age group. Inflammation was seen most commonly in the 40-50 age groups. Others included congenilal cataracts, retrolental fibrous tissue, retinoblastoma, vitritis, bullous keratopathy. These were a common cause in 0-10 age group.

TABLE-11

INVOLVEMENT OF BOTH EYES

AGE	NO.	%
0-10	3	42.8%
10-20	0	0%
20-30	2	28.6%
30-40	1	14.3%
40-50	0	0%
50-60	1	14.3%
60-70	0	0%
70-80	0	0%
	7	

Both eye involvements were found in 7 cases with the 0-10 age group being maximally involved. The findings in these cases included Retinoshcisis, Exudative RD and

Retinoblastoma. Others included Papillodema, Eales with vitreous hemorrhage, high myopia and diabetic retinopathy.

ULTRASONOGRAPHIC DIAGNOSIS

Retinal Detachment- 49

Total RD -42

- Bullous-20
- Shallow-5
- Funnel -Open-3

  -Closed-1

- Tractional –8
- Exudative RD-5

Focal RD-7

- Superior RD-2
- Inferior RD-5

Vitreous hemorrhage -34

PVD- 17

Increased Axial Length-5

IOFB- 7

Dropped IOL- 3

Dislocated Lens- 1

Choroidal Detachment- 6

Coloboma Choroid- 1

Microphthalmos- 2

Disc Edema- 5

Macular Edema- 1

Posterior Staphyloma- 2

Vitritis- 5

Cyclitic Membrane- 2

Endophthalmitis- 9

- Post operative- 3
- Post traumatic-6

Choroidal Thickening- 2

PHPV- 2

Persistent Hyaloid Remnants- 1

ROP- 2

Scleral Dehiscence- 1

Vitreous degeneration- 1

Retinal degeneration, calcification- 1

Retinoschisis- 3

Mass Lesions- 7

- Retinoblastoma-3
- Choroidal mass-2
- Optic nerve infiltration-1
- Mass orbit-1

TABLE 12

0- 10yrs

DIAGNOSIS	NO.	PERCENT
Microphthalmos	1	5.9
Increased axial length	1	5.9
Persistent hyaloid remnants	1	5.9
PVD	1	5.9
Coloboma choroid	1	5.9
PHPV	1	5.9
Vitreous hemorrhage	1	5.9
Disc edema	1	5.9
Exudative RD	3	17.6
Retinoblastoma	3	17.6
Retinoschisis	3	17.6
	17	100

Exudative RD, Retinoblastoma and Retinoschisis were all found to be commonly seen in this age group.

TABLE 13

10 – 20 years

DIAGNOSIS	NO.	PERCENT
Vitreous hemorrhage	10	35.6
PVD	4	14.3
RD	7	25
Vitritis	1	3.6
IOFB	4	14.3
Sclera dehiscence	1	3.6
Choroidal mass	1	3.6
	28	100

The most common lesion found was Vitreous hemorrhage unlike RD found in most other groups

TABLE 14

20 – 30 years

DIAGNOSIS	NO.	PERCENT
IOFB	2	6.3
Choroidal detachment	1	3.1
Vitreous hemorrhage	4	12.5
Retinal detachment	9	28
Disc edema	2	6.3
PVD	3	9.4
Increased axial length	1	3.1
Posterior staphyloma	2	6.3

Endophthalmitis	3	9.4
Cyclitic membrane	1	3.1
Vitreous degeneration	1	3.1
Microphthalmia	1	3.1
Choroidal thickening	1	3.1
Retinal degeneration	1	3.1
	32	100

Retinal Detachment was the commonest diagnosis seen followed a distant second by Vitreous hemorrhage. As trauma was commonly associated with this group more cases of endophthalmitis, choroidal detachment and IOFB were seen.

TABLE 15

30 – 40 years

DIAGNOSIS	NO.	PERCENT
RD	5	33.2
Choroidal thickening	1	6.7
Dislocated lens	1	6.7
Vitreous hemorrhage	3	20
PVD	1	6.7
Endophthalmitis	2	13.3
IOFB	1	6.7
Infiltrated mass lesion optic nerve	1	6.7
	15	100

The common diagnosis included RD followed by Vitreous hemorrhage**.** Intraocular tumors in the form of infiltrated optic nerve was noted

TABLE 16

40 – 50 years

DIAGNOSIS	NO.	PERCENT
Increased axial length	3	8.6
PVD	7	20
RD	8	22.6
Choroidal secondaries	1	2.6
Endophthalmitis	1	2.6
Macular edema	1	2.6
Choroidal detachment	3	8.6
Vitreous hemorrhage	8	22.6
Cyclitic membrane	1	2.6
Choroidal thickening	1	2.6
Vitritis	1	2.6
	35	100

Both Retinal Detachment and Vitreous hemorrhage were common in this group. Three patients were also seen to have increased axial length. Choroidal secondaries were seen in one person.

TABLE 17

50 -60 years

DIAGNOSIS	NO.	PERCENT
Vitreous hemorrhage	3	17.6
Mass orbit	1	5.9
RD	6	35.3
Choroidal detachment	1	5.9
Choroidal thickening	1	5.9
Endophthalmitis	3	17.6
Dislocated IOL	1	5.9
Vitritis	1	5.9
	17	100

The number of patients with RD was twice that of Vitreous hemorrhage with RD at 35.3% and Vitreous Hemorrhage at 17.6%. Endopthalmitis was seen in three patients

TABLE 18

60 – 70 years

DIAGNOSIS	NO.	PERCENT
RD	6	50
Vitreous hemorrhage	4	33.4
PVD	1	8.3
Choroidal detachment	1	8.3
	12	100

50 % of this group had Retinal Detachment as opposed to 33.4 % with Vitreous hemorrhage

TABLE 19

70 – 80

DIAGNOSIS	NO.	PERCENT
IOL	1	16.6
Choroidal thickening	1	16.6
Vitritis	1	16.6
RD	3	50.2
	6	100

Retinal Detachment was commonly seen in this group. A dropped IOL was located in one case. 3 port pars plana vitrectomy was done in this case and IOL removed.

DISCUSSION

In the 100 eyes we studied we were able to demonstrate and confirm the size location shape and area of lesions like retinal detachment, vitreous hemorrhage, IOFB, retinoblastoma, retinopathy of prematurity and many others.

In our study retinal detachments were come across most in 49 cases. These included rhegmatogenous, tractional and exudative detachments. Fresh retinal detachments showed highly reflective membranes that inserted into the optic nerve and showed variable movement. Long standing RDs appeared as funnel shaped or T shaped highly reflective membranes with minimal after movement. Differentiating early detachments and longstanding RD was helpful in planning type and time of surgery. In exudative RD repeat USG examination helped in monitoring the response to medical treatment. Churg J.P.et al highlighted the use of B scan in his article in detection of traction, retinal tears and hemorrhagic RD.In their study Retinal Detachment was come across most. These findings alter the surgical management.

In cases of vitreous hemorrhage, causes included post traumatic and spontaneous (due to vasculitis). In our study 34 such cases were seen. Most cases were associated with trauma. We were able to differentiate early from late vitreous hemorrhage. 10 cases were long standing and the rest were recent. Those

associated with tractional component were taken up for vitrectomy. In 'Role of ultrasound in ocular trauma, 2001', Verma.M.et al pointed out the efficacy of Bscan detecting the density and location of the hemorrhage which he noted in 55 of his cases.

PVD in or study were usually associated with vitreous hemorrhage or retinal detachments. Follow up ultrasonic examination to evaluate the changes such as absorption, further organization or extent of detachment is important in preoperative assessment.

Trauma as the most common cause of hazy media was noted in 42 cases. Both blunt and penetrating trauma led to cataract, hyphema, vitreous hemorrhage, choroidal detachment, endophthalmitis, vitritis, macular edema, scleral dehiscence. A case of dislocated lens was also noted. E. Puodžiuviene et al, Kaunas University has reported B scan as the most common and useful method for rapid assessment in ocular trauma. Posterior segment findings detected in his study included vitreous hemorrhage, PVD, IOFB, Choroidal rupture, Retinal Detachment which correlates with our study

Retinoblastoma was seen in 3 cases with all cases presenting in the 0-10 yrs group. All the cases we saw were typical cases presenting with leucocorea. Atypical signs include hypopyon, hyphema, uveitis, endophthalmitis, vitreous hemorrhage, or orbital cellulites. Ultrasound is also useful to monitor response to

radiotherapy or chemotherapy. Other mass lesions studied included choroidal

secondaries and an infiltrated mass lesion of optic nerve. We did not come across any

atypical presentations of Retinoblastoma.

One baby with retrolental fibrous tissue showed evidence of stage V Retinopathy of Prematurity.

We studied nine cases of endophthalmitis. USG helped us to confirm diagnosis, find associated lesions like RD, choroidal detachment. Low to meduim amplitude vitreous opacities, vitreous membranes and choroidal thickening were commonly seen.

Taraprasad et al has discussed in ‘Ocular ultrasound in preoperative evaluation of posterior segment of eye’ the accuracy of Bscan. 43 out of 50 cases were found to have correct diagnosis which helped in early management of these cases. They were also able to detect conditions like posterior staphyloma, as in our study, which explained the cause of poor visual acuity.

In cases of IOFB, USG helped locate it in traumatized eyes with hyphema traumatic cataract and vitreous hemorrhage.Seven such cases were seen in our study.

SUMMARY AND CONCLUSION

In eyes with opaque media the extent and location of structural damage to the posterior segment was assessed.

Ultrasonography has helped us immensely in diagnosis and proper evaluation of patients and in planning our surgery in cases that were operated.

One can assess the ultimate visual prognosis in these cases.

One can asses the topography of mass lesions so also confirm the diagnosis especially when retinoblastoma or PHPV was suspected.

The causes for diminished vision in cases due to trauma were found and treatment planned accordingly.

The importance and necessity of ultrasonographic scanning when direct visualisation of the posterior segment by normal optical means is not possible due to opaque ocular media are stressed

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